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HAROLD L. ICKES, SECRETARY

BUREAU OF MINES
R. R. SAYERS, ACTING DIRECTOR

INFORMATION CIRCULAR

SOME INFORMATION ON REDUCTION OF QUARRY ACCIDENTS

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BY

FRANK E. CASH AND FORREST H. SHUFORD

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UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

SOME INFORMATION ON REDUCTION OF QUARRY ACCIDENTS[1]

By Frank E. Cash[2] and Forrest H. Shuford[3]

INTRODUCTION

The compensation-insurance rates for quarrying in North Carolina are 11 times higher than for the State's major industry, textiles. Some operators are willing to accept this as representing the ratio of existing hazards. This was not true of the management of the Southern Aggregates Corporation, and in 1935 it took definite steps to correct the idea of its local officials and employees that loss of life and limb in quarries is inevitable.

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The authors acknowledge gratefully the assistance and information concerning these operations furnished by H. M. Shaw, safety director (also secretary and treasurer), Southern Aggregates Corporation, Raleigh, N. C.; by the following superintendents: J. H. Rodgers, Blair Quarry, Blair, S. C.; J. D. Lane, Greystone and Rolesville Quarries, Henderson, N. C.; J. H. Arthur, Guilquarry, Stokesdale, N. C.; J. H. Watkins, Rockton Quarry, Wendell, N. C.; P. A. Wellenborne, Reidsville Quarry, Reidsville, N. C.; and J. L. Kirchin, Woodleaf Quarry, Woodleaf, N. C.; by the various foremen at the plants, and by Murray M. Grier, safety engineer, North Carolina Department of Labor, Asheville, N. C.

OPERATION

The Southern Aggregates Corporation, Raleigh, N. C., operates 7 quarries - 6 in North Carolina and 1 in South Carolina. The quarries in North Carolina are operated under the name of the Raleigh Granite Co. and the quarry in South Carolina under the name of the South Carolina Granite Co. All of these plants are engaged in quarrying granite and manufacturing crushed and sized stone for use on railroads as ballast, for highways, municipal streets, and other concrete construction.

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[1] The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from Bureau of Mines Information Circular 7114."
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A description of the several plants and quarries is essential in callin attention to plans and results in accident-prevention efforts.

The Rockton and Greystone quarries will be described in detail and the other five briefly, with special reference to variations from the first two.

Rockton Quarry

Rockton quarry is about 1 mile east of Wendell, Wake County, N. C. This pit is approximately 6 acres in area and is now being worked with a 90-foot face, benched down on 30-foot steps, and drilled with wagon and well drills. The wagon-drill holes are loaded with 1-1/2-by 8-inch gelatin dyna and 30 or 40 of these holes are shot simultaneously. The stone is then drilled with jackhammers, and the holes are loaded with gelatin dynamite, which is shot with fuse and detonators. The charge of dynamite is varied according to the size of the rock. All fuse is prepared at a detonator magazine (situated some distance from the quarry) and cut into 42-inch lengths; the detonator is attached to the fuse by a bench-type crimper. This assures uniform lengths and clean, square-cut ends. All charges are loaded by the powderman, and at noon and night the eight drillmen, supervised by their foremen, light all of the block-hole shots. Hot-wire lighters with a safety fuse match on the end, together with a scratch stick for lighting these fuse matches, are given to each of these men. They then station themselves at various points over the broken stone where they have been drilling, so that they may readily know the locations of the charges of dynamite, and on a whistle signal from the powderman these men light their hot-wire lighters, holding them in the air so that the powderman may see that they are ready to begin lighting the fuses. The powderman then lights two fuses 21 inches in length, to which detonators have been attached. He then signals the men to start lighting the fuses of the shots to be fired. When the detonators attachedto the two shorter fuses go off, the men immediately stop lighting and go for shelter to an old boiler, the flues of which have been cut out and in which seats have been provided and a door has been put in one end. After firing has ceased the men remain under cover for what is believed to be a safe period and then examine the muck pile for signs of unlighted fuses and misfires.

The stone is loaded into trucks by one electric shovel with a 2-yard dipper and one small steam shovel with a 3/4-yard dipper. It is hauled to the dump and dumped by an air hoist into one of two pit cars, which are pulled by a hoisting engine and dumped into a 30-inch gyratory crusher. This crusher discharges onto a conveyor belt, and the stone is carried to a double-deck screen, the top deck of which has 4-inch openings and the lower deck 2-1/2- to 1-inch openings, depending on the size of the product being made. The discharge from the top deck goes to a 13-inch Superior McCully crusher; the discharge from the top of the bottom deck goes to a bucket elevator which takes this material to the screen plant on top of the storage bins. The discharge from these two crushers goes to a conveyor belt, which carries it to a storage bin over the conveyor that takes the discharge from the 30-inch crusher, thus closing the circuit.

All equipment at this plant, except the steam shovel and two gas cranes sed in stock-pilding, is driven by individual electric motors, the power or which is purchased. This power is delivered by the power company at ,300 volts. Some of the motors are 2,300-volt and others are 440, 220, nd 100, these voltages being obtained by transformers situated at various oints on the property, the main distribution voltage being 2,300 volts.

Compressed air for the jackhammers, wagon drills, and air hoists is urnished by a two-stage air compressor driven by a 200-horsepower electric otor.

In 1938, 158,000 tons of rock waw produced, using 62,000 pounds of explosives and requiring 600 horsepower daily to operate the plant.

This plant is equipped with floodlights, so that at present two 8-hour shifts are being worked, each employing about 75 men.

Greystone Quarry

Greystone quarry is at Greystone, Vance County, N. C., about 4 miles northeast of Henderson, N. C., on the main line of the Seaboard R. R. Quarries have been operated at this point for about 75 years. This company began operating the present quarry in 1916. This pit now covers approximately 15 acres and is 200 feet deep at its deepest point. Two levels are being operated, the lower one having a 75-foot face and the upper one a 100-foot face.

Primary drilling is done with well drills, 6-inch holes being spaced approximately 20 feet apart with 20-foot face and drilled 5 feet below grade. In the past these holes were loaded with 75- and 60-percent gelatin dynamite and fired with electric detonators and Cordeau, but for the past 2 years "Nitromon" has been used for primary blasting. The size of these primary shots changes from time to time, the largest having been loaded with approximately 30,000 pounds of explosives. The secondary drilling is handled as in the Rockton quarry. Two old boilers, one on each level, are provided for shelter. Stone at the lower level is loaded by a Diesel shovel and at the upper level by an electric shovel, each with a 2-yard dipper. These shovels load the stone into 5-cubic-yard cars pulled by gasoline locomotives to the foot of inclines, whence the cars are pulled by a hoist up to the switching yard. They are then handled by a gasoline locomotive and switched to the foot of another incline, whence another hoisting engine pulls them to the dump over a 48- by 60-inch jaw crusher. The discharge of this crusher feeds onto a conveyor belt that carries the stone to a double-deck vibrating screen. The discharge from the upper deck goes to a 5-1/2-foot cone crusher. The discharge from the bottom deck goes to a 4-foot cone crusher and material passing through the bottom deck to a bucket elevator, which carries it to a screening plant on top of the storage bins. The discharge from the 5-1/2-foot and 4-foot cone crushers goes to a conveyor belt, which discharges on the storage pile. From a tunnel under this storage pile is a conveyor belt that discharges on the bottom deck of the screen mentioned above. The final sizing of the stone on top of the storage bins is handled by a vibrating screen. About 90 percent of the production from this plant (which in 1938 was 294,000 tons) is shipped by railroad. This plant is powered by individual-drive electric motors, 440, 220, and 110 volts A.C. The electric powe is purchased at 2,300 volts A.C. Approximately 118,000 pounds of explosive was used at this plant in 1938.

Rolesville Quarry

Rolesville quarry is on a branch line of the Atlantic Coast Line R. R. in Wake County about 4 miles east of Wake Forest, N. C. This plant has been in operation since 1922. The area of this quarry is approximately 9 acres, and a 65-foot face is being worked. Drilling is done by well drill, and "Nitramon" is used, as at the Greystone quarry. Stone is loaded by a 550-volt electric shovel with a 2-yard dipper. It is loaded into semi-trailer trucks, which haul and dump direct into a 48- by 60-inch jaw crusher below the level of the quarry floor. This crusher discharges onto a conveyor belt, which takes the stone out of the quarry and discharges over a scalping screen into a 16-inch crusher. The throughs from the scalping screen and the discharge from the 16-inch crusher go over another scalping screen to a 4-inch cone crusher. The discharge from this crusher goes to a bucket elevator that carries the stone to the sizing plant on top of the storage bins. In 1938 this plant shipped 178,000 tons, virtually all by rail, and used approximately 71,000 pounds of explosives. All equipment except stock-piling cranes is driven by electric motors, the power being purchased at 2,300 volts A.C. The larger motors are operated at this voltage, while transformers at various places step the voltage down to 550, 440, and 110 for the smaller motors.

Guilquarry

Guilquarry, in Guilford County, is about 18 miles northwest of Greensboro, N. C. This quarry formerly was operated by Guilford County but was bought by the Raleigh Granite Co. in 1932; it covers approximately 7 acres, the main walls are 90 feet high, and a sublevel with 30-foot walls is being developed. At present virtually all of the drilling at this quarry is done by wagon drills carrying a 30-foot face, and the stone is loaded by hand int 2-cubic-yard pit cars, which are pushed by hand to the foot of an incline, up which they are hauled by a hoisting engine and dumped into a 13-inch jaw crusher. The discharge from this crusher passes over a scalping screen into a 4-foot cone crusher, the discharge of which is carried by bucket elevators to the sizing screen on top of the storage bin. This plant is served by the Atlantic & Yadkin R. R., but about 90 percent of its output is hauled away by truck. In 1938 this plant produced 98,000 tons of stone.

Reidsville Quarry

Reidsville quarry is approximately 1-1/2 miles north of Reidsville, N. C., in Rockingham County, and has been operated by the Raleigh Granite Co. since 1936. It is the smallest operation, producing only 28,000 tons of stone in 1938 and is about 1-1/2 acres in area; a 20-foot face is being operated. Primary drilling is done by wagon drills and secondary drilling by jackhammers, while blasting is done as in the Rockton quarry.

Woodleaf Quarry

Woodleaf quarry is on the Southern Ry. in Rowan County about 11 miles rom Salisbury. This quarry is approximately 12 acres in area, is 100 feet eep, and in 1938 produced 341,000 tons. Primary drilling is done by well rills. The stone is loaded by a 2,300-volt electric shovel and a steam hovel, and trucks are dumped directly into a No. 12 gyratory crusher be- ow the quarry floor. This crusher discharges to a conveyor belt, which akes the stone out of the quarry and discharges onto a vibrating screen. he secondary crushers are a 7-1/2 standard 10-inch gyratory and a 4-foot one crusher.

Blair Quarry

Blair quarry was opened by the South Carolina Granite Co. in 1927 in irfield County, about 40 miles northwest of Columbia, S. C., on the Southern . There are two quarries at this operation, one approximately 10 acres and e other 6 acres in area. The face now being worked is approximately 80 et high. In 1938 this plant produced 222,000 tons. Primary drilling is ne by well drills, and the stone is loaded by 2,300-volt electric shovel d a 7/8-yard gas shovel. The stone is loaded in trucks and hauled up a ight incline to the plant, where it is dumped into a 48- by 60-inch jaw usher. The discharge from this crusher goes to an 18-inch gyratory usher, which discharges to a conveyor belt that carries the stone to the orage pile. From a tunnel under this pile a belt conveyor discharges e stone onto a vibrating screen, and the stone from the top deck of this reen goes into a bucket elevator, which carries it to the sizing plant er the storage bins. At this plant the company does its own switching, erating one steam locomotive and one gas locomotive, which shift all cars d deliver them to the connection with the Southern Railroad, about a mile om the plant.

EXCESSIVE NUMBER OF ACCIDENTS

A review of the accident costs for the fiscal year ended June 30, 1935, resented the following alternative to the secretary and treasurer of the ompany: Reduce the accident cost or go out of business.

During that fiscal year three men were killed, while numerous permanent njuries and far too many other lost-time injuries were experienced. The requency rate was 115.00 and the severity rate was 36.10. In view of this ery unsatisfactory record, company officials determined to take positive teps to reduce the number and severity of accidents.

Compensation costs were becoming a vital factor in the cost of pro- uction, and a different course of action was essential for financial easons, aside from humanitarian considerations.

ACCIDENT-PREVENTION PROCEDURE

Information was obtained from the North Carolina Industrial Commission the National Safety Council, the North Carolina Department of Labor, and the Federal Bureau of Mines as to what other quarries and similar plants were doing in regard to the prevention of accidents. The information was assembled and digested, and a brief abstract or form of recommended procedure, together with the corporation's accident experience was presented to the directors.

On graphic presentation of facts and a proposed safety program, the directors gave the secretary and treasurer additional help, designated him as safety director, and instructed him to put into effect the proposed safety program.

Undoubtedly neither the directors nor the safety director realized the extent of the task, but it was authorized and undertaken.

The North Carolina General Assembly of 1935 passed an occupational-disease law, which recognized silicosis. The first step in the safety program, therefore, was to give all employees a complete and thorough physical examination, including X-ray pictures and interpretations, and to provide for similarly examining all future employees.

In September 1935 the North Carolina Department of Labor and the company's insurance carrier were requested to rigidly inspect the physical condition of all plants and quarries. These inspection reports were sent, as received, to the various plant superintendents with instructions to comply with all recommendations as promptly as possible. If a superintendent considered any of the recommendations impractical, he was required to give his reason to the safety director, who had authority to acce or overrule the superintendent's suggestions and to insist on compliance with the recommendations.

In November 1935 the safety director, all superintendents, the North Carolina quarry inspector, and the insurance carrier's engineer inspected each plant to ascertain whether the recommendations of the September inspection had been carried out and to outline and discuss the new safety program with the supervisors. Superintendents were instructed that safety was to be placed at least on a par with production. To stimulate interest, each foreman was offered a leather jacket if his pit, quarry, or plant ran the rest of the year (approximately 2 months) without a lost-time accident; only two of the six quarries had accidents during that period.

Feeling that the workmen should participate in prizes for preventing accidents, beginning with 1936 a barbecue was offered for each quarry operating 3 months without a lost-time accident. This has been found effective in maintaining the interest of the individual employees and has been continued.

In spite of this safety work, three fatal accidents occurred between July 1, 1935, and August 1, 1936.

The next step was the formulation of a set of safety rules. This as accomplished by having each superintendent submit a set of safety ules, which were combined and revised by the safety director and re-urned to the various plants for constructive criticism. These critiisms were studied and various changes made in the rules again before they ere printed, distributed, and put into force.

The following rules have been issued to quarries controlled by the outhern Aggregates Corporation:

COMPILED FROM SUGGESTIONS OF SAFETY COMMITTEES

It is the policy of the company to produce stone without injury to any employee. With this in view, the company has provided certain safeguards and adopted certain rules.

To prevent injury to an employee or his fellow workman, cooperation of each is necessary.

It is expected and earnestly desired that an employee shall not endanger his safety in the work of the company.

The attached rules are for employees' guidance. Each employee is expected to learn and obey them. If an employee cannot do this, the company prefers that he seek employment elsewhere, as he is not the man the company wants.

These rules and regulations have been approved by the North Carolina Industrial Commission. In accordance with the laws of the State, any employee, if injured while violating any of the attached rules, will reduce his compensation to the extent provided by the laws.

GENERAL RULES

Applicable to All Employees at All Times

The employee is prohibited from:

1. Having liquor on the job, or coming on the job under the influence of liquor.

2. Indulging in horseplay or pranks.

3. Throwing any material over the face of the quarry. (This does not apply to men barring down rock on instruction from their foreman.)

4. Handling or touching any equipment, tools, explosives, electric wires, motors, switches, conduit, or other electrical equipment unless required to do so as a part of his job.

5. Riding on any conveyor, elevator, rock skip, or pit car.

6. Riding on trucks, dinkies, shovels, or cranes unless his job requires this.

7. Cleaning, adjusting, or oiling any equipment while in motion unless specifically instructed by his foreman to do so.

8. Putting belt dressing on conveyors in motion.

9. Using gasoline for cleaning equipment or tools.

10. Using gasoline, oil, or kerosene for starting fires.

11. Smoking or having open fire or flame when handling, or near, dynamite, powder, fuse, caps, oil, or gasoline.

The employee is required to:

12. Wear clothing without ragged or loose pieces that might be caught in machinery.

13. Wear safety shoes in good condition.

14. Have goggles with him at all times and wear these whenever there is danger of flying or falling material. Also, to wear these goggles at all places specifically required by these rules and at such other places as may be required by his foreman.

15. Wear hard hat at all times when working as crusher feeder, cathole man, railroad-car loader under bins, and at such other places as foreman may require him to wear hard hat.

16. Wear respirator where so instructed by foreman.

17. Report at once to his foreman any injury, no matter how slight it may seem. Blood poisoning usually starts from slight cuts, blisters, and the like.

18. When injured, report at once to the office for first-aid treatment or for instructions as to medical aid, and report to the office thereafter as instructed.

19. Use regular walkways and stairs when entering or leaving job.

20. Take shelter under suitable roof, of at least 2-inch oak boards, immediately when the blasting signal is given, and remain there until the signal has been given that the blasting is all over. Men working under direct supervision of

their foreman, on his instruction, may wait until signal is given by blasting cap before taking cover. They may also leave cover on instruction from their foreman.

21. Get assistance when carrying heavy equipment or materials. Use the leg muscles, keeping the back straight and shoulders higher than the hips. Do not overtax the strength, but get help.

22. Give notice to fellow employees before releasing materials being carried by more than one person.

23. Keep material, equipmeht, tools, and scrap at points provided.

24. Keep the place where he works clean, to prevent injury to himself or a fellow workman from tripping or stumbling or being hit by a falling object.

25. Ask his foreman about anything on his job that is not understood or entirely clear. Do not guess. Do not take chances.

26. See that equipment and tools are in good condition before using them. If they are not, or if they have become damaged or out of order, he shall report it to his foreman at once.

The employee should:

27. Cooperate with "the other fellow." His help may be needed sometimes.

28. Help correct unsafe practices and conditions by reporting them immediately to his foreman.

29. Keep on the alert for all dangers; do not stand under swinging loads or on tracks or at other such places.

SPECIAL RULES

Applicable to Powder Men and Any Men Handling Explosives

The employee is prohibited from:

30. Using iron tools for opening cases, tamping holes, or in connection with dynamite or caps. Wooden, copper, or brass tools must be used.

31. Keeping dynamite, powder, caps, or fuse at any place other than regular magazines provided. Employee's pockets and tool boxes are not regular magazines.

32. Storing, carrying, or hauling caps in the same magazine, container, or vehicle with dynamite.

33. Keeping more than one day's supply of explosives in the quarry magazine or leaving any in the quarry magazine over the week-end.

34. Using teeth or any method other than cap crimpers for crimping cap to fuse.

35. Removing cap from fuse after having been crimped. The fuse shall be cut with a knife 1 or 2 inches from the cap.

36. Loading more than one charge of explosives in a single rock, unless the charges are to be fired by electric exploders or cordeau fuse.

37. Using any electric exploders of different makes in the same shot.

38. Lighting any fuse after the signal cap has gone off when lighting pop shots.

The employee is required to:

39. Read and comply with all of the manufacturer's printed instructions governing the handling of explosives, which are placed in each container of dynamite and caps. These are made a part of these rules.

40. Report all misfires to the foreman immediately.

41. Cut fuse for pop shots and for signal caps to lengths specified by the foreman.

42. Use two signal caps.

43. Keep the magazines and premises around the magazines clean at all times. See that nails are bent over or removed from dynamite boxes before discarding.

44. Keep the dynamite and caps magazines in the quarry at least fifteen feet apart.

SPECIAL RULES

Applicable to Truck Drivers and Dinky Drivers

The employee is prohibited from:

45. Staying on truck while it is being loaded or on a dinky while the car next to it is being loaded by shovel or crane.

46. Standing on truck bumper while cranking truck.

47. Moving a truck forward or backward unless he can see where he is going and can see that no one is in the way. If he cannot see, he should have someone flag and he should not move the truck until the flagman give the signal that the way is clear.

48. Racing with other truck drivers.

The employee is required to:

49. Make no attempt to cut off the gas should his truck or dinky catch on fire, but he shall put the fire out with a fire extinguisher.

50. Immediately report to his foreman any defect in his truck steering gear or brakes.

51. See that the spark is retarded before attempting to crank engine.

52. Keep the thumb alongside the forefinger and not around the crank when cranking engine.

The employee should:

53. Take extreme caution to prevent injury from hot water or steam, on removing radiator cap when motor is hot enough to boil water in radiator.

SPECIAL RULES

Applicable to Drillers and Hand Rock Loaders

The employee is prohibited from:

54. Drilling in old holes.

55. Drilling within two feet of missed shot.

56. Drilling more than one hole in a rock to be shot with fuse.

57. Drilling above or below another driller.

58. Drilling unless both feet are on the ground. Do not put leg over drill.

59. Smoking or throwing matches or cigarette butts near loaded hole or while powder man is loading hole near him.

60. Lighting any fuse that has been cut off. Report this to the powder man.

The employee is required to:

61. Warn fellow workmen before starting to bar down rock.

62. Use water when drilling, except during freezing weather.

63. Stop lighting pops immediately when the signal cap goes off, and immediately go to shelter provided.

64. Keep hose and connection tight and in good condition.

65. Wear goggles at all times, when breaking or loading rock, or when within 10 feet of anyone breaking or loading rock.

The employee should:

66. Report to his foreman any dangerous wall or face condition noticed.

67. Watch for any missed shots or loose dynamite and report such to his foreman at once.

68. When possible face the quarry wall when working, so that any loose stone will be noticed.

69. Make sure of footing and be particularly careful against slipping or falling when steppihg on stone.

70. When drilling stand so that falling can be avoided should the steel break.

SPECIAL RULES

Applicable to Shovel Operators, Crane Operators and Their Helpers

The employee is prohibited from:

71. Loading any truck while the driver is in the cab or anyone is on the truck.

72. Handling or touching electric shovel cable without rubber gloves and rubber boots.

The employee is required to:

73. Remain on the shovel in the event of electrical trouble, until the main switch to shovel cable has been pulled, except under foreman's instructions to the contrary.

74. Report at once to his foreman any damaged insulation on electric shovel cable. The shovel operator is required to make a daily inspection of this cable.

The employee should:

75. Make repairs on electric shovel only when the current has been cut off, unless the character of the repairs makes it necessary to have current available.

76. Not allow the electric cable to lie in water, but support it on benches when necessary.

77. Be sure that the fuse or overload device at the end of the cable, away from the shovel, is in proper working order. Report to the foreman immediately should this equipment get out of order.

SPECIAL RULES

Applicable to Crusher Feeders and Helpers

The employee is prohibited from:

78. Using a solid bar or piece of drill steel as a pinchbar; use a piece of pipe.

The employee is required to:

79. Wear goggles at all times.

80. Where provided, wear safety belt when prying rock or when leaning or climbing over crusher.

81. Stand away from the crusher, out of danger of falling or rolling rock, when cars or trucks are being dumped.

82. Stand back out of danger when chaining rock, so that should the chain break it will not hit him.

SPECIAL RULES

Applicable to Railroad Car Loaders and Yard Men

The employee is prohibited from:

83. Bumping cars, except under personal supervision of the foreman.

84. Pinching a car off that is on a grade, unless there is a man stationed at the brake-wheel of the car.

85. Being on or in any car while railroad locomotive is doing any shifting, unless flagman is stationed to give warning.

The employee is required to:

86. Keep railroad cars within limits designated by clearance posts.

87. Examine brakes before moving car. Any cars found with bad brakes must be let down while coupled to another car with good brakes.

88. Use heavy wooden brake-stick for braking cars. The use of the hands alone, iron bars, or drill steel is not permitted.

89. Get off of a car immediately should the car get out of control. It is better that the car be damaged than a man killed.

90. Have a flagman in front of a car that is being let down by gravity, pulled by hoisting engine, or that is being switched by a dinky, unless there is a man on the front end of a car or cars.

The employee should:

91. When riding cars stand inside of car or ride with one leg hooked over side of car, where possible.

92. Avoid crossing track ahead of a moving car.

93. Avoid getting off in front of a moving car.

94. Where possible, pull brake-stick towards inside of car, so that should brake-stick or chain break he will not fall off the car.

SPECIAL RULES

Applicable to Repair Men and Maintenance Men, Their Helpers, and Operators of All Power Machinery

The employee is prohibited from:

95. Starting any machine until he is certain that all other employees are in the clear.

96. Receiving signals, except in case of emergency, from any employee other than the one designated to give such signals.

97. Removing any guard from any machine while machine is in operation, or operating any machine with guard off.

98. Doing any work on charged electrical circuit. This applies to 110-volt circuits as well as circuits carrying higher voltages.

99. Disconnecting or taking out air or water line without first being sure that this line is not serving as an electrical ground to some piece of equipment. If so, be sure that the current to this equipment has been cut off.

100. Using any makeshift electrical extension cord. Use only properly insulated and grounded extension cords.

101. Using any leaking acetylene or oxygen hose.

102. Looking at any electric welding arc, unless suitable goggles are being worn. Goggles for acetylene welding are not suitable for electric welding.

103. Working near electric welding, unless protected from arc by a screen to cut off the glare.

104. Using bolts in chains, except when used for unchoking crushers. Repair links and hooks must be used.

105. Using broken tools or tools with mushroomed heads.

106. Leaving tools, materials, or refuse in walkways or on stairs.

107. Throwing anything from overhead structures, except under direct instructions from the foreman. Even then, be sure that there is no one below who might be hit.

The employee is required to:

108. Have fuse removed, switch locked, or someone stationed at the switch or control, when any work is done on any power circuit, motor, or machine, so that the electric current cannot be turned on or machine started and injure a man working on circuit or machine.

109. Remove or bend over all nails before discarding or storing any lumber, so that injury to anyone from nails will be prevented.

110. Keep all tools in first-class condition and turn in to his foreman at once any broken or damaged tool.

111. Wear proper goggles at all times when welding, cutting, grinding, chipping, pouring metal, hammering on any metal, or working beneath machinery.

The employee should:

112. Carefully examine scaffolds or any temporary structures, to see that they are safe, before using them. Do not take any chances.

113. See that his wrench has a good grip on the nut or pipe before pulling, and further see that he is in such position that should the wrench slip he will not fall.

114. When holding a striking bar, wrench, or chisel, stand so that should the man using the striking-hammer miss it would do as little harm as possible. He should also see that his hands are in such position that they will not be caught between the bar or wrench and some other object. Before moving bar, wrench, or chisel be sure that the man using the hammer knows that this is to be done.

SPECIAL RULES

Applicable to Foreman or Anyone Acting in That Capacity

The foreman is required to:

115. Give each new employee detailed instructions as to the proper way of performing the job and as to the hazards incidental to the job, before putting him to work. The foreman must be convinced that the new employee fully understands the instructions. Each new employee must be given a copy of the safety rules immediately upon being employed, and the foreman must explain the rules to the employee at the time he gives him the rules.

116. See that the men working under him are equipped with proper shoes, goggles, helmets, and other necessary protective equipment. It is the foreman's responsibility to see that this equipment is used.

117. Make sure that every employee assigned to a hazardous job is thoroughly instructed in precautions necessary to minimize hazard. Do not permit work on any job until the job has been made safe.

118. When two or more men are sent off to work together, at a place not under the direct supervision of the foreman, designate one man as being in charge.

119. Keep a written record of any violation of these rules and file this in the quarry office weekly.

120. Accept the responsibility for the proper use and maintenance of safeguards in his department.

121. Assign one man to handle the starting of machinery and equipment, and this man must be held responsible by the foreman for seeing that no one is in position to be injured, before machinery is started.

122. See that warning signs are available and used at all times.

123. Carefully supervise the construction of all scaffolds and platforms and require that adequate factor of safety be provided in all such construction.

124. Have all roads leading to the quarry flagged and warning given, before each blast.

125. Make daily inspection of all working places to eliminate hazards.

126. Be present and in charge of all shooting of explosives. (Pit foreman or his assistant.)

127. Investigate all accidents involving serious actual injury, also all accidents which might have caused serious actual injury. The investigation report must be written and filed at the quarry office and must indicate the accident cause and the foreman's suggestion for removing the cause.

128. Give patient and considerate attention to reports and suggestions of employees as to unsafe equipment, tools, conditions, and methods, and where practicable act on such suggestions promptly.

AN OPERATING SAFETY PROGRAM

The set-up used in carrying on this safety work is as follows: Safety director and safety committees, composed of superintendents, foremen, and several of the workmen, which meet twice a month. The safety committees appoint safety inspectors, who make semimonthly inspections and file their reports with the committee. Minutes of the meetings of the safety committees are kept. Copies of these minutes, together with copies of the safety-inspection reports, are sent to the safety director, who follows up to see that these meetings and inspections are held regularly and that interest in maintained. Copies of all accident reports, whether medical, first-aid, or lost-time were sent to the safety director for the first 18 months. Since then only the medical and lost-time accidents have been reported to the safety director. A record of first-aid injuries is kept at the quarries in a note book so that the safety director may review all accidents and analyze the cause when he visits the plants. Each month each quarter, and at the end of each year a summary is made showing the number of man-hours worked at each plant, the number of lost-time accidents, the amount of lost time involved, and the frequency and severity rates. These reports are sent to each of the quarries and to each executive of the company.

The safety committees discuss and investigate all first-aid, medical, and lost-time accidents. Serious accidents are investigated thoroughly by the safety committees and by the safety director. The cause and suggested methods of prevention of all accidents, both major and minor, are passed from each quarry to all the others so that each quarry may benefit from the experiences of the others. The State Department of Labor and the insurance carrier have been requested to make rigid and frequent inspection and all their recommendations have been accepted. On various occasions the State Department of Labor inspector has accompanied a representative of the Federal Bureau of Mines whose knowledge, gained from similar work in severa States, could be used in furthering the safety program.

The company washes the stone and uses water sprays to allay the dust in the crushers. All drilling is wet in summer, and in winter drill runner wear approved respirators.

Several hundred men have availed themselves of the first-aid courses that have been made available by the Company through the North Carolina Department of Labor in conjunction with the Federal Bureau of Mines and through the North Carolina Industrial Commission. All of the men at the quarries are required to wear safety shoes, bought and kept in stock by the company at each of the quarries and sold to the men at cost. All the men are furnished goggles by the company. All electrical equipment is grounded, and electric-shovel trailing cables have ground wires in them. Men handling these cables are also required to wear linemen's rubber gloves and to wear either rubber boots or, in dry weathor, electrician's shoes while handling trailing cables.

Results

During 1937 two of these quarries went the entire year without a lost-time accident and were given awards by the National Crushed Stone Association, and one was given honorable mention in the National Safety Competition conducted by the Bureau of Mines. During 1938 three of these plants went the entire year without lost-time accidents.

Since August 1, 1936, this company has worked more than 3,100,000 man-hours without a fatal accident. Had its accident record continued at the rate before the beginning of the safety program 13 men would have been killed. During this period it has had 44 lost-time accident; had it continued at the previous rate, it would have had 354 lost-time accidents. The accident-frequency rate has been reduced from 115 in 1934-35 to 12 in 1937 and 16 in 1938, and the sevority rate from 36.1 to 2.20 in 1937 and 5.64 in 1938. Some of the outstanding records made by individual plants are as follows:

Blair quarry has worked from June 5, 1936, through September 8, 1938, 400,000 man-hours, without a lost-time accident.

Woodleaf quarry has worked from November 17, 1937, to date (May 30, 1939), 330,000 man-hours, without a lost time accident.

Rolesville quarry has worked from July 5, 1936, to February 1, 1939, 219,000 man-hours, without a lost-time accident.

Although the practices at these various operations are by no means perfect, the experience of the Southern Aggregates Corporation for the past 5 years is proof that accidents can be reduced and prevented in any industry when managements realize that safeguarding employees actually lowers cost of production.